Claims

1. A process for the production of paper from an aqueous suspension containing cellulosic fibers, and optional fillers, which comprises separately adding to the suspension

(i) a cationic organic polymer having one or more aromatic groups, the cationic organic polymer being added in an amount of at least 0.001% by weight based on dry cellulosic fibers and optional fillers; and

(ii) an anionic polymer having one or more aromatic groups, the anionic polymer being added in an amount of at least 0.001% by weight based on dry cellulosic fibers and optional fillers, and the anionic polymer being selected from the group consisting of step-growth polymers, polysaccharides, and naturally occurring aromatic polymers and modifications thereof, with the proviso that the anionic polymer is not an anionic melamine-sulphonic acid condensation polymer;

forming and draining the obtained suspension on a wire.

2. The process of claim 1, wherein the cationic organic polymer is cationic starch.

3. The process of claim 1, wherein the cationic organic polymer is an acrylamide-based polymer.

4. The process of claim 1, wherein the cationic organic polymer has a weight average molecular weight above about 1,000,000.

5. The process of claim 1, wherein the anionic polymer is an anionic benzene-based or naphthalene-based step-growth polymer.

6. The process of claim 5, wherein the anionic polymer is prepared from one or more aromatic compounds selected from the group consisting of phenyl, phenol, naphthalene, naphthol, and mixtures thereof.

7. The process of claim 1, wherein the anionic polymer is a lignin-based polymer.

8. The process of claim 1, wherein the anionic polymer is selected from the group consisting of tannin extracts, sulphonated lignins, benzene sulphonic acid based condensation polymers, benzene sulphonate based condensation polymers, xylen sulphonic acid based condensation polymers, xylen sulphonate based condensation

polymers, naphthalene sulphonic acid based condensation polymers, naphthalene sulphonate based condensation polymers, phenol sulphonic acid based condensation polymers, phenol sulphonate based condensation polymers, and mixtures thereof.

9. The process of claim 1, wherein the anionic polymer is an anionic polyurethane.

10. The process of claim 1, wherein the anionic polymer has a weight average molecular weight within the range of from 500 to 1,000,000.

11. The process of claim 1, wherein it further comprises adding a low molecular weight cationic organic polymer to the suspension prior to adding the cationic organic polymer having one or more aromatic groups.

12. The process of claim 1, wherein the suspension has a conductivity of at least 2.0 mS/cm.

13. The process of claim 1, wherein it further comprises recycling white water and introducing from 0 to 30 tons of fresh water per ton of paper produced.

14. A process for the production of paper from an aqueous suspension containing cellulosic fibers, and optional fillers, which comprises separately adding to the suspension

(i) a cationic organic polymer having one or more aromatic groups, the cationic organic polymer being added in an amount of at least 0.001% by weight based on dry cellulosic fibers and optional fillers; and

(ii) an anionic polymer having one or more aromatic groups, the anionic polymer being added in an amount of at least 0.001% by weight based on dry cellulosic fibers and optional fillers, with the proviso that the anionic polymer is not an anionic polystyrene sulphonate or anionic melamine-sulphonic acid condensation polymer;

forming and draining the obtained suspension on a wire.

15. A process for the production of paper from an aqueous suspension containing cellulosic fibers, and optional fillers, which comprises separately adding to the suspension

(i) a cationic polysaccharide having one or more aromatic groups, the cationic polysaccharide being added in an amount of at least 0.005% by weight based on dry cellulosic fibers and optional fillers; and

(ii) an anionic polymer having one or more aromatic groups, the anionic polymer being added in an amount of at least 0.001% by weight based on dry cellulosic fibers and optional fillers, and the anionic polymer being selected from the group consisting of step-growth polymers, polysaccharides, and naturally occurring aromatic polymers and modifications thereof, with the proviso that the anionic polymer is not an anionic melamine-sulphonic acid condensation polymer;

forming and draining the obtained suspension on a wire.

16. The process of claim 15, wherein the cationic polysaccharide is cationic starch.

17. The process of claim 15, wherein the cationic polysaccharide has a benzyl group.

18. The process of claim 15, wherein the anionic polymer is an anionic step-growth polymer.

19. The process of claim 18, wherein the anionic step-growth polymer is prepared from one or more aromatic compounds selected from the group consisting of phenyl, phenol, naphthalene, naphthol, and mixtures thereof.

20. The process of claim 15, wherein the anionic polymer is a naturally occurring aromatic polymer or modification thereof.

21. The process of claim 20, wherein the anionic polymer is a lignin-based polymer.

22. The process of claim 15, wherein the anionic polymer is selected from the group consisting of tannin extracts, sulphonated lignins, benzene sulphonic acid based condensation polymers, benzene sulphonate based condensation polymers, xylen sulphonic acid based condensation polymers, xylen sulphonate based condensation polymers, naphthalene sulphonic acid based condensation polymers, naphthalene sulphonate based condensation polymers, phenol sulphonic acid based condensation polymers, phenol sulphonate based condensation polymers, and mixtures thereof.

23. The process of claim 15, wherein the anionic polymer is an anionic polyurethane.

24. The process of claim 15, wherein the anionic polymer has a weight average molecular weight within the range of from 500 to 1,000,000.

25. The process of claim 15, wherein the cationic polysaccharide is added in an amount of from 0.005 to 3% by weight based on dry cellulosic fibers and optional fillers.

26. The process of claim 15, wherein the anionic polymer is added in an amount of from 0.005 to 1.5% by weight based on dry cellulosic fibers and optional fillers.

27. The process of claim 15, wherein it further comprises adding a low molecular weight cationic organic polymer to the suspension prior to adding the cationic polysaccharide.

28. The process of claim 15, wherein the suspension has a conductivity of at least 2.0 mS/cm.

29. The process of claim 15, wherein it further comprises recycling white water and introducing from 0 to 30 tons of fresh water per ton of paper produced.

30. A process for the production of paper from an aqueous suspension containing cellulosic fibers, and optional fillers, which comprises separately adding to the suspension

(i) a cationic starch having one or more aromatic groups, the cationic starch being added in an amount of at least 0.005% by weight based on dry cellulosic fibers and optional fillers; and

(ii) an anionic polyurethane having one or more aromatic groups, the anionic polyurethane being added in an amount of at least 0.001% by weight based on dry cellulosic fibers and optional fillers;

forming and draining the obtained suspension on a wire.

31. The process of claim 30, wherein the cationic starch is cationic potato starch or cationic waxy maize starch.

32. The process of claim 30, wherein the anionic polyurethane has a weight average molecular weight within the range of from 500 to 1,000,000.

33. The process of claim 30, wherein the anionic polyurethane is prepared from a monomer mixture comprising toluene-2,4-diisocyanate, toluene-2,6-diisocyanate, diphenyl-methane-4,4'-diisocyanate or a mixture thereof.

34. The process of claim 30, wherein it further comprises adding a low molecular weight cationic organic polymer to the suspension prior to adding the cationic polysaccharide.

35. The process of claim 30, wherein the suspension has a conductivity of at least 3.5 mS/cm.

36. The process of claim 30, wherein it further comprises recycling white water and introducing from 0 to 30 tons of fresh water per ton of paper produced.

37. A process for the production of paper from an aqueous suspension containing cellulosic fibers, and optional fillers, which comprises separately adding to the suspension

(i) a cationic starch having one or more aromatic groups, the cationic starch being added in an amount of at least 0.005% by weight based on dry cellulosic fibers and optional fillers; and

(ii) an anionic benzene-based or naphthalene-based condensation polymer, the anionic condensation polymer being added in an amount of at least 0.001% by weight based on dry cellulosic fibers and optional fillers;

forming and draining the obtained suspension on a wire.

38. The process of claim 37, wherein the cationic starch is cationic potato starch or cationic waxy maize starch.

39. The process of claim 37, wherein the anionic condensation polymer is prepared from one or more aromatic compounds selected from the group consisting of phenyl, phenol, naphthalene, naphthol, and mixtures thereof.

40. The process of claim 37, wherein the anionic condensation polymer is selected from the group consisting of benzene sulphonic acid based condensation

polymers, benzene sulphonate based condensation polymers, xylen sulphonic acid based condensation polymers, xylen sulphonate based condensation polymers, naphthalene sulphonic acid based condensation polymers, naphthalene sulphonate based condensation polymers, phenol sulphonic acid based condensation polymers, phenol sulphonate based condensation polymers, and mixtures thereof.

41. The process of claim 37, wherein it further comprises adding a low molecular weight cationic organic polymer to the suspension prior to adding the cationic starch.

42. The process of claim 37, wherein the suspension has a conductivity of at least 3.5 mS/cm.

43. The process of claim 37, wherein it further comprises recycling white water and introducing from 0 to 30 tons of fresh water per ton of paper produced.

44. A process for the production of paper from an aqueous suspension containing cellulosic fibers, and optional fillers, which comprises separately adding to the suspension

(i) a cationic starch having one or more aromatic groups, the cationic starch being added in an amount of at least 0.005% by weight based on dry cellulosic fibers and optional fillers; and

(ii) an anionic lignin-based polymer having one or more aromatic groups, the anionic lignin-based polymer being added in an amount of at least 0.001% by weight based on dry cellulosic fibers and optional fillers;

forming and draining the obtained suspension on a wire.

45. The process of claim 44, wherein the cationic starch is cationic potato starch or cationic waxy maize starch.

46. The process of claim 44, wherein the anionic lignin-based polymer is a sulphonated lignin.

47. The process of claim 44, wherein it further comprises adding a low molecular weight cationic organic polymer to the suspension prior to adding the cationic starch.

48. The process of claim 44, wherein the suspension has a conductivity of at least 3.5 mS/cm.

49. The process of claim 44, wherein it further comprises recycling white water and introducing from 0 to 30 tons of fresh water per ton of paper produced.

50. A process for the production of paper from an aqueous suspension containing cellulosic fibers, and optional fillers, which comprises separately adding to the suspension

(i) a cationic vinyl addition polymer having one or more aromatic groups, the cationic vinyl addition polymer being added in an amount of at least 0.001% by weight based on dry cellulosic fibers and optional fillers; and

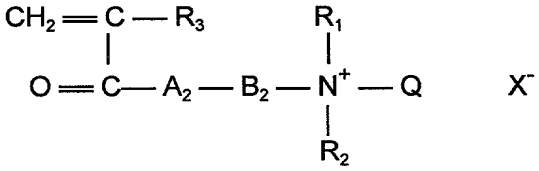
(ii) an anionic lignin-based polymer having one or more aromatic groups, the anionic lignin-based polymer being added in an amount of at least 0.001% by weight based on dry cellulosic fibers and optional fillers;

forming and draining the obtained suspension on a wire.

51. The process of claim 50, wherein the anionic lignin-based polymer is a sulphonated lignin.

52. The process of claim 50, wherein the cationic vinyl addition polymer is an acrylamide-based polymer.

53. The process of claim 50, wherein the cationic vinyl addition polymer is prepared by polymerization of a monomer mixture comprising a cationic monomer represented by the general structural formula (II):



(II)

wherein R_3 is H or CH_3; R_1 and R_2 are alkyl having from 1 to 3 carbon atoms; A_2 is O or NH; B_2 is an alkyl or alkylene group having from 2 to 4 carbon atoms, or a hydroxy propylene group; Q is a benzyl group; and X^- is an anionic counterion.

54. The process of claim 50, wherein the cationic vinyl addition polymer is vinylamine-based polymer.

55. The process of claim 50, wherein it further comprises adding a low molecular weight cationic organic polymer to the suspension prior to adding the cationic vinyl addition polymer.

56. A process for the production of paper from an aqueous suspension containing cellulosic fibers, and optional fillers, which comprises separately adding to the suspension

(i) a cationic vinyl addition polymer having one or more aromatic groups the cationic vinyl addition polymer being added in an amount of at least 0.001% by weight based on dry cellulosic fibers and optional fillers; and

(ii) an anionic polyurethane having one or more aromatic groups, the anionic polyurethane being added in an amount of at least 0.001% by weight based on dry cellulosic fibers and optional fillers;

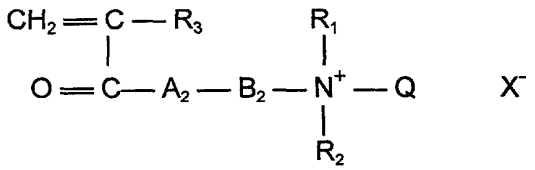
forming and draining the obtained suspension on a wire.

57. The process of claim 56, wherein the anionic polyurethane has a weight average molecular weight within the range of from 500 to 1,000,000.

58. The process of claim 56, wherein the anionic polyurethane is prepared from a monomer mixture comprising toluene-2,4-diisocyanate, toluene-2,6-diisocyanate, diphenyl-methane-4,4'-diisocyanate or a mixture thereof.

59. The process of claim 56, wherein the cationic vinyl addition polymer is an acrylamide-based polymer.

60. The process of claim 56, wherein the cationic vinyl addition polymer is prepared by polymerization of a monomer mixture comprising a cationic monomer represented by the general structural formula (II):



(II)

wherein R_3 is H or CH_3; R_1 and R_2 are alkyl having from 1 to 3 carbon atoms; A_2 is O or NH; B_2 is an alkyl or alkylene group having from 2 to 4 carbon atoms, or a hydroxy propylene group; Q is a benzyl group; and X^- is an anionic counterion.

61. The process of claim 56, wherein the cationic vinyl addition polymer is a vinylamine-based polymer.